

Also by DAVID S. LANDES

BANKERS AND PASHAS

THE UNBOUND PROMETHEUS

REVOLUTION IN TIME

The
Wealth and Poverty
of Nations

*Why Some Are So Rich
and Some So Poor*

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tradicted the ultimate responsibility of the higher authorities in this domain, especially in conscripting and assigning labor for the larger tasks: the big dikes, dams, and canals, flood control, repair and relief. Such interventions went far beyond local possibilities. The stakes were huge. For one thing, the more daring the alteration of nature, the greater the scope and cost of failure or catastrophe.¹⁶ For another, it was food surpluses that sustained the machinery of government.

This was the reality. As one team of scholars put it, repudiating Wittfogel the while, "There must be irrigable land available, adequate social hegemony and state control, and so on."¹⁷ Yes indeed.

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European Exceptionalism: A Different Path

Europe was lucky, but luck is only a beginning. Anyone who looked at the world, say a thousand years ago, would never have predicted great things for this protrusion at the western end of the Eurasian landmass that we call the continent of Europe. In terms popular among today's new economic historians, the probability at that point of European global dominance was somewhere around zero. Five hundred years later, it was getting close to one.

In the tenth century, Europe was just coming out of a long torment of invasion, plunder, and rapine, by enemies from all sides. From what we now know as Scandinavia, the Norsemen or Vikings, marine bandits whose light boats could handle the roughest seas and yet sail up shallow rivers to raid and pillage far inland, struck along the Atlantic coasts and into the Mediterranean as far as Italy and Sicily. Others went east into Slavic lands, establishing themselves as a new ruling class (the Rus, who gave their name to Russia and ruled that somber land for some seven hundred years), and eventually penetrating almost to the walls of Constantinople.

So terrifying were these marauders, so ruthless their tactics (taking pleasure in tossing babes in the air and catching them on their lances, or smashing their heads against the wall), that the very rumor of their

arrival loosened the limbs and loins of the population and sent their leaders, including their spiritual guides, in headlong flight, carrying their movable wealth with them. The clerics did leave their parishioners some newly composed prayers for protection by the Almighty, but the altar was not a good refuge, for the Vikings knew where the plunder lay and headed straight for churches and castles.

Also coming from the sea, across the Mediterranean, were Saracens (Moors), who set up mountain bases in the Alps and on the Côte d'Azur, and went out from these to raid the trade routes between northern and southern Europe. These fastnesses, hard of access and yet linked to Muslim lands by the sea, were inexpugnable, and folk legend has it that to this day some villagers in the high Alps carry the color and appearance of their Maghrebin origins.

Finally, from the east overland, but highly mobile for all that, rode the Magyars or Hungarians, one more wave of invaders from Asia, pagans speaking a Ural-Altai language (a distant cousin of Turkish), sweeping in year after year, choosing their targets by news of European dissensions and dynastic troubles, swift enough to move in a single campaign from their Danubian bases into eastern France or the foot of Italy. Unlike the Norsemen, who were ready to settle into base camps for a period of years, the better to hunt and find, or who even established themselves quasi-permanently as rulers in part of England, in Normandy (which took their name), and in Sicily, the Hungarians went out and back, hauling their booty and slaves along with them in wagons or on pack animals.

No one will submit to that kind of abuse indefinitely. The Europeans learned to counter these thrusts, with or without the help of their leaders, who were only too quick to make their own deals with the invaders on the backs of their peasants. Instead of trying to keep the Norsemen out, the villagers let them in, trapped them, fell on them from all sides.* The Hungarians, too swift to deal with when they came in, were slow going out; a few ambushes of the overproud, overloaded trains convinced them that there must be better ways to make a living. As for the Saracens, the solution lay, as in Muslim lands, in military escorts for mule and wagon trains (caravans). In short, the Europeans raised the price of aggression. In all these instances, ironically, the Europeans were assisted by enemy headquarters. Over the years, the northern tribes and the Hungarian invaders settled down and became

* This is the theme of, though not the inspiration for, the film *The Magnificent Seven*. Comparable situations lead to comparable tactics.

domesticated. Kingdoms replaced nomadic war camps, and their rulers looked with disfavor on these swaggering "captains," with their private armies and tales of derring-do, returning from their raids with booty and brags, and threatening the peace. Kings do not need career troublemakers. A mix of threat and reward succeeded in persuading rogues and pirates that more was to be gained by being landlords and shearing sheep at home than by being warlords and killing sheep abroad.

It has been suggested that this end to danger from without launched Europe on the path of growth and development. This is the classical economists' view: increase is natural and will occur wherever opportunity and security exist. Remove the obstacles, and growth will take care of itself. Others would argue that freedom from aggression is a necessary but not sufficient condition. Growth and development call for enterprise, and enterprise is not to be taken for granted. Besides, medieval Europe did not lack for impediments to such initiatives.

To get an idea of the larger character of this process, one has to see the Middle Ages as the bridge between an ancient world set in the Mediterranean—Greece and then Rome—and a modern Europe north of the Alps and Pyrenees. In those middle years a new society was born, very different from what had gone before, and took a path that set it decisively apart from other civilizations.

To be sure, Europe had always thought of itself as different from the societies to the east. The great battles between Greeks and Persians—Salamis, Thermopylae—have come down in folk memory and in the classes of yesteryear as symbolic of the combat between West and East, between the free city (the *polis*, which gives us our word "politics") and aristocratic empires,¹ between popular sovereignty (at least for free men) and oriental despotism (servitude for all). In those days one was taught that the Greeks invented democracy, the word and the idea. This is still the conventional wisdom, though substantially modified by an awareness of Greek slavery and of their exclusion of women from the political process (though not from public space).

Linked to the opposition between Greek democracy and oriental despotism was that between private property and ruler-owns-all. Indeed, that was the salient characteristic of despotism, that the ruler, who was viewed as a god or as partaking of the divine, thus different from and far above his subjects, could do as he pleased with their lives and things, which they held at his pleasure. And what was true for the ruler was true for his henchmen. The martial aristocracy typically had a monopoly of weapons, and ordinary folk were careful not to offend

them, arouse their cupidity, or even attract their attention; to look them in the eye was an act of impudence that invited severest punishment.

Today, of course, we recognize that such contingency of ownership stifles enterprise and stunts development; for why should anyone invest capital or labor in the creation or acquisition of wealth that he may not be allowed to keep? In the words of Edmund Burke, "a law against property is a law against industry."² In Asian despotisms, however, such arrangements were seen as the very raison d'être of human society: what did ordinary people exist for, except to enhance the pleasure of their rulers?

Certainly not to indulge a will of their own. The experience of the people of Balkh (central Asia) is emblematic. It so happened their ruler was away making war on the Indians, and a nomadic people nearby took advantage of his absence to seize the city. The inhabitants put up a good fight, defending not only their own houses and families but those of the absent ruler; but they lost. When the ruler returned, he retook the city; and when he learned of his subjects' valor, he scolded them. War, he lectured, was not their affair; their duty was to pay and obey whoever ruled them. The leaders of the common folk duly apologized and promised not to repeat their *lèse-majesté*.³

In these circumstances, the very notion of economic development was a Western invention. Aristocratic (despotic) empires were characteristically squeeze operations: when the elites wanted more, they did not think in terms of gains in productivity. Where would these have come from? They simply pressed (and oppressed) harder, and usually found some hidden juice. Sometimes they miscalculated and squeezed too hard, and that could mean flight, riot, and opportunities for rebellion. These autocracies, though defined as divine, were not immortal. Meanwhile only societies with room for multiple initiatives, from below more than from above, could think in terms of a growing pie.

The ancient Greeks distinguished between free and unfree, not so much in terms of material benefits (they were not particularly keen on economic enterprise, which they associated with metics and other crass people), or even in terms of the advantages of their own system, as of the wrongness of the other, which they saw as tyranny. And yet the Greeks succumbed to despotism, most spectacularly in the empire created by Alexander and ruled by his Asian and Egyptian successors; and later the Romans went the same way, sliding all too easily into tyrannical autocracy. In final form, the classical Mediterranean world came to resemble politically the civilizations to the east—a powerful and

small elite surrounded by clients, servants, and slaves, and headed by an autocrat. But only resembled. Dissenters knew this was wrong, spoke up and wrote, and suffered for their presumption. The republican ideal died hard.

Meanwhile property rights had to be rediscovered and reasserted after the fall of Rome. This world, which we know as medieval—the time between—was a transitional society, an amalgam of classical legacy, Germanic tribal laws and customs, and what we now call the Judaic-Christian tradition. All of these provided support for institutions of private property. The Germanic custom was that of a nomadic community, with each warrior master of his modest possessions—kept modest by constant movement. Nothing was so special and valuable as to give rise to issues of ownership or to the ambitions of power.*

Which is not to say that there were not other incentives to power; or that the condition of these nomadic peoples was immutable. In the course of their wanderings and conquests, such issues did arise. Every French grammar school student used to learn the story of the vase of Soissons, a beautiful object robbed from a church by the Franks in war against the Gauls. The chief Clovis wanted to return it, by way of giving pleasure to a Christian woman who had won his fancy, but the soldier who had taken it (or had been awarded it in the division of the booty) refused. It was his by right, and he broke it in front of Clovis to make his point. In effect, he told his chief, what's yours is yours and what's mine is mine. The next time the troops were drawn up in array, Clovis stopped before the vase-breaker and asked him what was wrong with his sandal; and when the man bent down to look, Clovis shattered his skull with a battle-ax. In effect, what's yours is yours, but you are mine.[†]

Tensions and ambiguities, then. But what mattered in the long run were the constraints imposed by political fragmentation and general insecurity. In the centuries that followed the end of empire, the arm of authority was short. Power derived in principle from the freely con-

* "The acquisition of valuable and extensive property, therefore, necessarily requires the establishment of civil government. Where there is no property, or at least none that exceeds the value of two or three days labour, civil government is not so necessary."—Adam Smith, *Wealth of Nations*, Book 5, ch. 1, Part 2. Smith was thinking here of the protection of private property; but these considerations also apply to the uses of power.

† After years of telling of this apocryphal exchange (versions vary, but that's folklore), French teachers were afraid to ask their students who broke the vase of Soissons, because there would always be one wiseacre in the class to deny it. Cf. Bonheur, *Qui a cassé*, p. 77.

PRIVATE PROPERTY

FRAGMENTATION

sented allegiance of the group or an elite within it and was correspondingly limited. To be sure, the tradition of election gave way to hereditary rule (the Germans were much influenced by Roman example, or rather principle). But old customs and appearances died hard: the ruler, even when designated by birth, was nominally elected. So he was earthly, human rather than divine, and his power the same.

Some did seek to restore the empire that had been. The dream of Rome reborn/never died.⁴ Had they succeeded, one might have expected a revival of arbitrary despotism. But such efforts broke down in the face of poor communication, inadequate transport, challenges to legitimacy, the contrary power of local rulers, the triumph of reality over fantasy. In this context, private property was what could be held and defended. Sometimes it was seized by force, just as today someone might be mugged and robbed. But the principle never died: property was a right, and confiscation, no more than plunder, could not change that.

The concept of property rights went back to biblical times and was transmitted and transformed by Christian teaching. The Hebrew hostility to autocracy, even their own, was formed in Egypt and the desert: was there ever a more stiff-necked people? Let me cite two examples, where the response to popular initiative is directly linked to the sanctity of possessions. When the priest Korach leads a revolt against Moses in the desert, Moses defends himself against charges of usurpation by saying, "I have not taken one ass from them, nor have I wronged any one of them" (Numbers 16:15). Similarly, when the Israelites, now established in the Land, call for a king, the prophet Samuel grants their wish but warns them of the consequences: a king, he tells them, will not be like him. "Whose ox have I taken, or whose ass have I taken?" (I Samuel 12:3).

This tradition, which set the Israelites apart from any of the kingdoms around and surely did much to earn them the hostility of nearby rulers—who needs such troublemakers?—tended to get lost in Christianity when that community of faith became a church, especially once that Church became the official, privileged religion of an autocratic empire. One cannot well bite the hand that funds. Besides, the word was not getting out, for the Church early decided that only qualified people, certain clerics for example, should know the Bible. The Good Book, with its egalitarian laws and morals, its prophetic rebukes of power and exaltation of the humble, invited indiscipline among the faithful and misunderstanding with the secular authorities. Only after censorship and edulcoration could it be communicated to the laity. So

that it was not until the appearance of such heretical sects as the Waldensians (Waldo, c. 1175), the Lollards (Wiclif, c. 1376), Lutherans (1519 on), and Calvinists (mid-sixteenth), with their emphasis on personal religion and the translation of the Bible into the vernacular, that this Judaic-Christian tradition entered explicitly into the European political consciousness, by way of reminding rulers that they held their wealth and power of God, and then on condition of good behavior. An inconvenient doctrine.

Yet Western medieval Christianity did come to condemn the pretensions of earthly rulers—lesser monarchs, to be sure, than the emperors of Rome. (The Eastern Church never talked back to the Caesars of Byzantium.)* It thereby implicitly gave protection to private property. As the Church's own claims to power increased, it could not but emphasize the older Judaic principle that the real owner of everything was the Lord above, and the newer Christian principle that the pope was his vicar here below. Earthly rulers were not free to do as they pleased, and even the Church, God's surrogate on earth, could not flout rights and take at will. The elaborate paperwork that accompanied the transfer of gifts of the faithful bore witness to this duty of good practice and proper procedure.

All of this made Europe very different from civilizations around.

In China, even when the state did not take, it oversaw, regulated, and repressed. Authority should not have to depend on goodwill, the right attitude, personal virtue. Three hundred years before the Common Era, a Chinese moralist was telling a prince how to rule, not by winning the affection of his subjects but by ensuring their obedience. A prince cannot see and hear everything, so he must turn the entire empire into his eyes and ears. "Though he may live in the deepest retreat of his palace, at the end of tortuous corridors, nothing escapes him, nothing is hidden from him, nothing can escape his vigilant watch."⁵ Such a system depends on the honesty and capacity of the living eyes and ears. The ruler is at the mercy of ambitious subordinates, whose capacity for deception and hypocrisy is unbounded. The weakness of autocracy is in the human raw material. Fortunately.

One scholar, impervious to euphemisms, terms the system "totalitarian":

* This split between western and eastern Europe is only one aspect of a profound chasm that still exists. And most people in eastern Europe know which side of the line they want to be on. Hence the expansion of "central" Europe to include everyone outside Russia. Also the inclusionary plans of the European Union and NATO.

No private undertaking nor any aspect of public life could escape official regulation. In the first place there was a whole series of state monopolies. . . . But the tentacles of the Moloch state, the omnipotence of the bureaucracy, extended far beyond that. . . . This welfare state superintended, to the minutest detail, every step its subjects took from the cradle to the grave.⁶

ZMIRNY

Despotisms abounded in Europe, too, but they were mitigated by law, by territorial partition, and within states, by the division of power between the center (the crown) and local seigneurial authority.⁷ Fragmentation gave rise to competition, and competition favored good care of good subjects. Treat them badly, and they might go elsewhere.

Ecumenical empires did not fear flight, especially when, like China, they defined themselves as the center of the universe, the hearth and home of civilization, and everything outside as barbarian darkness. There was no other place to go, so that symbolic boundaries were enough, like the "willow palisade," a low wall that ran from the Great Wall to the sea and separated China from the Mongol-Tartar lands to the north. In a poem on the subject, the Qian Long emperor makes this point: "In our erection of boundaries and regulation of people, ancient ways are preserved, / As it is enough simply to tie a rope to indicate prohibition. . . . Building it is the same as not having built it: / Insofar as the idea exists and the framework is there, there is no need to elaborate."⁸

The contest for power in European societies (note the plural) also gave rise to the specifically European phenomenon of the semi-autonomous city, organized and known as commune. Cities of course were to be found around the world—wherever agriculture produced sufficient surplus to sustain a population of rulers, soldiers, craftsmen, and other nonfood producers. Many of these urban nodes came to acquire great importance as markets, to say nothing of their role as administrative centers. But nothing like the commune appeared outside western Europe.⁹

The essence of the commune lay, first, in its economic function: these units were "governments of the merchants, by the merchants, and for the merchants";¹⁰ and second, in its exceptional civil power: its ability to confer social status and political rights on its residents—rights crucial to the conduct of business and to freedom from outside interference. This meant everything in a hierarchical, agrarian society that held most of the population in thrall, either by personal dependence on local lords or ties to place. It made the cities gateways to freedom,

holes in the tissue of bondage that covered the countryside. *Stadtluft macht frei* ran the medieval dictum—city air makes one free. Literally: when the count of Flanders tried to reclaim a runaway serf whom he ran across in the market of Bruges, the bourgeois simply drove him and his bully boys out of the city.

The consequences were felt throughout the society. Under this special dispensation, cities became poles of attraction, places of refuge, nodes of exchange with the countryside. Migration to cities improved the income and status not only of the migrants but of those left behind. (But not their health. The cities were dirty, crowded, and lent themselves to easy contagion, so that it was only in-migration that sustained their numbers and enabled them to grow.) Serf emancipation in western Europe was directly linked to the rash of franchised villages and urban communes, and to the density and proximity of these gateways. Where cities and towns were few and unfree, as in eastern Europe, serfdom persisted and worsened.

Why did rulers grant such rights to rustics and townsmen, in effect abandoning (transferring) some of their own powers? Two reasons above all. First, new land, new crops, trade, and markets brought revenue, and revenue brought power.¹¹ (Also pleasure.) Second, paradoxically, rulers wanted to enhance their power within their own kingdom: free farmers (note that I do not say "peasants") and townsmen (*bourgeois*) were the natural enemies of the landed aristocracy and would support the crown and other great lords in their struggles with local seigneurs.

Note further that European rulers and enterprising lords who sought to grow revenues in this manner had to attract participants by the grant of franchises, freedoms, and privileges—in short, by making deals. They had to persuade them to come.¹² (That was not the way in China, where rulers moved thousands and tens of thousands of human cattle and planted them on the soil, the better to grow things.) These exemptions from material burdens and grants of economic privilege, moreover, often led to political concessions and self-government. Here the initiative came from below, and this too was an essentially European pattern. Implicit in it was a sense of rights and contract—the right to negotiate as well as petition—with gains to the freedom and security of economic activity.

Ironically, then, Europe's great good fortune lay in the fall of Rome and the weakness and division that ensued. (So much for the lamentations of generations of classicists and Latin teachers.) The Roman dream of unity, authority, and order (the *pax Romana*) remained, in-

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deed has persisted to the present. After all, one has usually seen fragmentation as a great misfortune, as a recipe for conflict; it is no accident that European union is seen today as the cure for the wars of yesterday. And yet, in those middle years between ancient and modern, fragmentation was the strongest brake on wilful, oppressive behavior. Political rivalry and the right of exit made all the difference.¹³

One other fissure helped: the split between secular and religious. Unlike Islamic societies, where religion was in principle supreme and the ideal government that of the holy men, Christianity, craving imperial tolerance, early made the distinction between God and Caesar. To each his own. This did not preclude misunderstandings and conflicts: nothing is so unstable as a dual supremacy; something's got to give. In the end, it was the Church, and this meant yielding to Caesar what was Caesar's and then a good part of what was God's. Among the things that gave, homogeneous orthodoxy: where authority is divided, dissent flourishes. This may be bad for certainty and conformity, but it is surely good for the spirit and popular initiatives.

Here, too, fragmentation made all the difference. The Church succeeded in asserting itself politically in some countries, notably those of southern Europe, not in others; so that there developed within Europe areas of potentially free thought. This freedom found expression later on in the Protestant Reformation, but even before, Europe was spared the thought control that proved a curse in Islam.

As for China, which had no established faith and where indeed an extraordinary religious tolerance prevailed, the mandarin and imperial court served as custodians of a higher, perfected lay morality and in that capacity defined doctrine, judged thought and behavior, and stifled dissent and innovation, even technological innovation. This was a culturally and intellectually homeostatic society: that is, it could live with a little change (indeed, could not possibly stifle all change); but as soon as this change threatened the status quo, the state would step in and restore order. It was precisely the wholeness and maturity of this inherited canon and ethic, the sense of completeness and superiority, that made China so hostile to outside knowledge and ways, even where useful.

One final advantage of fragmentation: by decentralizing authority, it made Europe safe from single-stroke conquest. The history of empire is dotted with such coups—one or two defeats and the whole eccumenical autocracy comes tumbling down. Thus Persia after Issus (333 B.C.E.) and Gaugamela (331 B.C.E.); Rome after the sack by Alaric

(410); and the Sassanian empire after Qadisiya (637) and Nehawand (642). Also Aztec Mexico and Inca Peru.

Europe, in contrast, did not have all its eggs in one basket.* In the thirteenth century the Mongol invaders from the Asian steppe made short work of the Slavic and Khazar kingdoms of what is now Russia and Ukraine, but they still had to cut their way through an array of central European states, including the new kingdoms of their predecessors in invasion—the Poles, Lithuanians, Germans, Hungarians, and Bulgars—before they could even begin to confront the successor states of the Roman empire. This they might well have done had they not been distracted by troubles back home; but they would have paid dearly for further gains, especially in forested areas. Shortly thereafter the Turks, who had established themselves in Anatolia, began to expand into Europe, conquering the Balkans, then the lower Danube Valley, and getting twice to the walls of Vienna, capital of Germany's eastern march. In the course of these advances, they subdued the Serbs, the Bulgars, the Croats, the Slovenes, the Albanians, the Hungarians, and sundry other peoples of that confused and quarrelsome palimpsest. But that was it; by the time they got to Vienna, they had reached the limit of their resources.†

Part of the brittleness of these empires, of course, derived from their exploitative, surplus-sucking character and the indifference of subjects to the identity of their rulers: one despot was the same as the next; one foreign clan as arrogant and predatory as another. Why should the inhabitants of Persia care what happened to Darius at the hands of Alexander? Or what happened nine hundred years later to the Sassanian monarchy at the hands of the Arabs? Why should the tired, oppressed Roman "citizens" of the last days of empire care whether Rome fell? Or the subject tribes of Mexico, for that matter, care what happened to Moctezuma? The classical Greeks (–5th century), who saw

* Already in late Roman times, Germanic tribes fought as allies alongside imperial forces to repel later invaders: thus Salian Franks, Visigoths, and others, with the Roman general Aetius against Attila's Huns at the so-called Battle of Chalons (somewhere near Troyes) in 451. Attila and his Huns have come down in European tradition as quintessential symbols of barbarism and savagery. But today's Turks do not feel that way: Attila is one of their favorite names.

† When they got to Vienna the second time, in 1683, the Turks found themselves facing not only Germans but the Poles of Sobieski. Europeans could work together when they thought they faced a common enemy. That this was a last gasp is shown by the rapid Ottoman retreat thereafter. In a short sixteen years, they left Hungary and pulled back to Bosnia and Serbia, thus giving up the middle Danube Valley to Christian settlement (Treaty of Karlowitz).

themselves as the defenders of freedom against Asian tyranny, perceived this indifference as their secret weapon:

Where there are kings, there must be the greatest cowards. For men's souls are enslaved and refuse to run risks readily and recklessly to increase the power of somebody else. But independent people, taking risks on their own behalf and not on behalf of others, are willing and eager to go into danger, for they themselves enjoy the prize of victory.¹⁴

Once the Europeans found themselves reasonably secure from outside aggression (eleventh century on), they were able, as never before and as nowhere else, to pursue their own advantage. Not that internal violence ceased from the land. The tenth and eleventh centuries were filled with baronial brigandage, eventually mitigated by popular, Church-supported revulsion and outrage that found expression in mass "peace" assemblies; and, from the top down, subdued by stronger central government allied with urban interests.¹⁵ Time and money were on the side of order. So was the diversion of brawlers to external frontiers (cf. the Crusades). The economist would say that once the exogenous shocks ended, the system could take care of its endogenous trouble-makers.

1350 - 1500

There ensued a long period of population increase and economic growth, up to the middle of the fourteenth century, when Europeans were smitten by the plague (the "Black Death") in its bubonic and pneumonic forms and a third or more of the people died; a half when you count the losses inflicted by sequellae. That was a jolt, but not a full stop. The one hundred fifty years that followed were a period of rebuilding, further technological advance, and continued development. In particular, these centuries saw the further expansion of a civilization that now found itself stronger than its neighbors, and the beginnings of exploration and conquest overseas.

This long multicentennial maturation (1000-1500) rested on an economic revolution, a transformation of the entire process of making, getting, and spending such as the world had not seen since the so-called Neolithic revolution. That one (c. -8000 to -3000) had taken thousands of years to work itself out. Its focus had been the invention of agriculture and the domestication of livestock, both of which had enormously augmented the energy available for work. (All economic [industrial] revolutions have at their core an enhancement of the supply of energy, because this feeds and changes all aspects of human ac-

tivity.) This shift away from hunting and gathering, bringing a leap in the supply of nourishment, permitted a substantial growth of population and a new pattern of concentrated settlement. It was the Neolithic revolution that made possible towns and cities, with all that they yielded in cultural and technical exchange and enrichment.

The medieval economic revolution also built on gains in the production and application of energy and concomitant increases in work. First, food supply: this was a period of innovation in the techniques of cultivation. I say innovation rather than invention because these new techniques went back earlier. Thus the wheeled plow, with deep-cutting iron share, had come in with the German invaders; but it had seen limited use in a world of limited animal power and low population density. Now it spread across Europe north of the Loire, opened up the rich river valleys, turned land reclaimed from forest and sea into fertile fields, in short did wonders wherever the heavy, clayey soil resisted the older Roman wooden scratch plow, which had worked well enough on the gravelly soils of the Mediterranean basin.

The wheeled plow turning heavy soil called for animals to match. We have already had occasion to speak of these big, stall-fed oxen such as were found nowhere else, and these large dray horses, more powerful if not stronger than the ox. These living, mobile engines offered a great advantage in a land-rich, labor-scarce economy. For time too was scarce: agricultural work has peaks of activity at sowing and harvest when one must seize good weather and get the seed in or crops out. Especially was this true of European communal agriculture, where scattered and intermingled holdings and open fields made for much to-and-fro and one peasant's haste was the haste of all his neighbors. Strong, quick animals could make all the difference, and cultivators pooled resources to get the right livestock.

Along with these superior techniques went, as both cause and effect, a more intensive cultivation, in particular, a shift from a two-field (one half left fallow every year) to a three-field system of crop rotation (winter grain, spring grain, and one third fallow). This yielded a gain of one third in land productivity (one sixth of total cultivable land, but one third of the half previously under cultivation), which further contributed to the ability to support livestock, which increased the supply of fertilizer, which nourished yields, and so on in ascending cycle. Given the character of land distribution and the collective use of draft animals, this critical change called for strong communal leadership and cooperation, made easier by example and results.

How much of this was response to population pressure and how

much a stimulus to increase is hard to say. No doubt both. But it would seem that over time, population began to outstrip the means of sustenance, because these centuries also saw a great effort to increase arable, whether by forest clearing (assarts) or reclamation of land from water, by diking, drainage, and pumping. All these call for enormous energy and capital, and their success testifies not only to private and collective initiative but to the ingenuity of a society that was learning to substitute machines for animal and human power. In particular, the windmill, tireless and faithful, was the key to the successful pumping of fens and polders. It was the windmill that made Holland.

Historians rightly emphasize gains in land productivity and output in a society overwhelmingly rural because compelled to devote most of its resources to feeding itself. Yet these advances were essentially permissive. It was the urban minority that held most of the seeds and secrets of transformation—technical, intellectual, political. To be sure, the towns and cities were themselves shaped by the countryside: immigrants from the fields brought with them values, habits, and attitudes that made more sense on the land and then set them as a straitjacket on urban activity. Thus the organization of tradesmen and craftsmen in corporate guilds assumed a zero-sum game—one man's increase was another's diminution—like pieces in a bounded field. Besides, the urban setting itself made it necessary to ration space and time, again with an eye to discouraging self-aggrandizement. So, no stealing a march and selling before a certain hour or after another; no price competition; no trade-off of quality and solidity for cheapness; no buying low ("jewing down," in popular parlance—bad habits always belong to someone else) to sell high; in short, no market competition. Everyone who did his job was entitled to a living. Laudable but static. The aim was an egalitarian social justice, but it entailed serious constraint on enterprise and growth—a safety net at the expense of income.

That was the principle. One should always assume that rules, then as now, were made to be broken. Business, like love, laughs at locksmiths. So in medieval Europe, where the move toward guild controls was as much a response to free dealing as the expression of an older morality. Cities and towns sprang up thick and ambitious; in France, the Low Countries, the Rhineland, rulers encouraged them by generous grants of privilege. But attempts to sustain local monopoly were thwarted by the growth of suburbs (faubourgs), where urban rules did not apply. There outsiders and Jews settled in, and journeymen worked for masters who had outgrown their shop. There market restrictions did not

hold. Hence pairings like Hamburg-Altona and Nürnberg-Fürth: old wealth, new wealth; decorum, disorder; tight access, free entry.

One inevitable consequence of active trade was selection by merit. This ran against the parity principle (equality of results), but it was not possible to impose uniformity of performance. Some craftsmen simply did better work and attracted buyers beyond their capacity. At the same time, the very effort to restrain competition by limiting access to mastership meant talent unemployed. It did not take much to bring together such masters and journeymen. Since the journeymen were often not permitted to work in the master's city shop (limits on size), they worked *en chambre* or in the suburbs. Here was the beginning of putting-out and division of labor, with substantial gains in productivity.

Urban closure was also thwarted by the spread of industrial production to the countryside. Agriculture, with its seasonal and irregular pattern of activity, offered a pool of untapped labor, the greater because outside the cities constraints on the use of female and child workers no longer applied. Women and children, grossly underpaid, gave more product for the penny. Early on (thirteenth century), then, merchants began to hire cottage workers to perform some of the more tedious, less skilled tasks. In the most important branch, the textile manufacture, peasant women did the spinning on a putting-out basis: merchants gave out (put out) the raw material—the raw wool and flax, and, later, cotton—and collected the finished yarn.

This shift to outsourcing initially encountered little resistance from urban workers; but when merchants started putting-out yarn to cottage weavers, they were attacking one of the most powerful vested interests of the day, the guild weavers of the towns. Then the fat was in the fire. In Italy, the autonomous cities, which held political control over the surrounding countryside, managed to destroy much of this "unfair" competition. In the Low Countries, the other great medieval center of cloth manufacture, urban weavers marched into the villages to break cottage looms; and although the country weavers fought back, the putting-out system was held in check for centuries. The one country where putting-out had a free field was England, where local political autonomies made it hard for the monarchy to sustain corporate (guild) claims to monopoly and where guilds were quickly reduced to ceremonial fraternities. By the fifteenth century, more than half the nation's woolen cloth was being made in rural cottages. This recourse to cheap labor lowered costs over competitors abroad, so that by the sixteenth century a country that had once been largely an exporter of pri-

mary products, including raw wool, was well on its way to becoming the premier manufacturing nation of Europe.

The economic expansion of medieval Europe was thus promoted by a succession of organizational innovations and adaptations, most of them initiated from below and diffused by example. The rulers, even local seigneurs, scrambled to keep pace, to show themselves hospitable, to make labor available, to attract enterprise and the revenues it generated. At the same time, the business community invented new forms of association, contract, and exchange designed to secure investment and facilitate payment. In these centuries a whole new array of commercial instruments came into use; commercial codes were elaborated and enforced; and partnership arrangements were devised to encourage alliances between lenders and doers, between the men who supplied the funds and merchandise and those who went to distant lands to sell and to buy. Almost all of this "commercial revolution" came from the mercantile community, bypassing where necessary the rules of this or that city or state, inventing and improvising new venues for encounter and exchange (ports and outports, *faubourgs*, local markets, international fairs), creating in short a world of its own like an overlay on the convoluted, inconvenient mosaic of political units.

They got thereby substantially enhanced security, a sharp reduction in the cost of doing business (what the economist calls "transaction costs"), a widening of the market that promoted specialization and division of labor. It was the world of Adam Smith, already taking shape five hundred years before his time.

4

The Invention of Invention

When Adam Smith came to write about these things in the eighteenth century, he pointed out that division of labor and widening of the market encourage technological innovation. This in fact is exactly what happened in the Europe of the Middle Ages—one of the most inventive societies that history had known. Some may be surprised: for a long time one saw these centuries as a dark interlude between the grandeur of Rome and the brilliance of the Renaissance. That cliché no longer holds in matters technological.¹

A few examples:

1. *The water wheel.* It had been known to the Romans, who began to do interesting things with it during the last century of the empire, when the conquests were over and the supply of slaves had shrunk almost to nothing. By then it was too late; order and trade were breaking down. The device may well have survived on Church estates, where it freed clerics for prayer. In any event, it was revived in the tenth and eleventh centuries, multiplying easily in a region of wide rainfall and ubiquitous watercourses. In England, that peripheral, backward island, the Domesday census of 1086 showed some 5,600 of these mills; the Continent had many more.

Even more impressive is the way waterpower technique advanced.

Millwrights increased pressure and efficiency by building dams and ponds and by lining the wheels up to utilize the diminishing energy for a variety of tasks, beginning with those that needed the most power, and descending. At the same time, the invention or improvement of accessory devices—cranks, toothed gears—made it possible to use the power at a distance, change its direction, convert it from rotary to reciprocating motion, and apply it to an increasing variety of tasks: hence not only grinding grain, but fulling (pounding) cloth, thereby transforming the woolen manufacture; hammering metal; rolling and drawing sheet metal and wire; mashing hops for beer; pulping rags for paper. “Paper, which was manufactured by hand and foot for a thousand years or so following its invention by the Chinese and adoption by the Arabs, was manufactured mechanically as soon as it reached medieval Europe in the thirteenth century. . . . Paper had traveled nearly halfway around the world, but no culture or civilization on its route had tried to mechanize its manufacture.”² Europe, as nowhere else, was a power-based civilization.

2. *Eyeglasses.* A seemingly banal affair, the kind of thing that appears so commonplace as to be trivial. And yet the invention of spectacles more than doubled the working life of skilled craftsmen, especially those who did fine jobs: scribes (crucial before the invention of printing) and readers, instrument and toolmakers, close weavers, metalworkers.

The problem is biological: because the crystalline lens of the human eye hardens around the age of forty, it produces a condition similar to farsightedness (actually presbyopia). The eye can no longer focus on close objects. But around the age of forty, a medieval craftsman could reasonably expect to live and work another twenty years, the best years of his working life . . . if he could see well enough. Eyeglasses solved the problem.

We think we know where and when the first spectacles appeared. Crude magnifying glasses and crystals (*lapides ad legendum*) had been found earlier and used for reading.³ The trick was to improve them so as to reduce distortion and connect a pair into a wearable device, thus leaving the hands free. This apparently first happened in Pisa toward the end of the thirteenth century. We have a contemporary witness (1306) who says he knew the inventor:

Not all the arts [in the sense of arts and crafts] have been found; we shall never see an end of finding them. Every day one could discover a new art. . . . It is not twenty years since there was discovered the art of making

spectacles that help one to see well, an art that is one of the best and most necessary in the world. And that is such a short time ago that a new art that never before existed was invented. . . . I myself saw the man who discovered and practiced it and I talked with him.⁴

These convex lenses were obviously not uniform or of what we would call prescription quality. But here medieval optical technology, however primitive, was saved by the nature of the difficulty: the lenses to correct presbyopia do not have to be extremely accurate. Their function is primarily to magnify, and although some magnify more than others, just about any and all will help the user. This is why people will occasionally borrow glasses in a restaurant to read the menu, and why five-and-dime stores can put out boxes of such spectacles for sale. The buyer simply tries a few and picks the most suitable. Myopes (short-sighted people) cannot do that.

That was the beginning. By the middle of the fifteenth century, Italy, particularly Florence and Venice, was making thousands of spectacles, fitted with concave as well as convex lenses, for myopes as well as presbyopes. Also, the Florentines at least (and presumably others) understood that visual acuity declines with age and so made the convex lenses in five-year strengths and the concave in two, enabling users to buy in batches and change with time.

Eyeglasses made it possible to do fine work and use fine instruments. But also the converse: eyeglasses encouraged the invention of fine instruments, indeed pushed Europe in a direction found nowhere else. The Muslims knew the astrolabe, but that was it. The Europeans went on to invent gauges, micrometers, fine wheel cutters—a battery of tools linked to precision measurement and control. They thereby laid the basis for articulated machines with fitted parts.

Close work: when other civilizations did it, they did it by long habituation. The skill was in the hand, not the eye-and-tool. They achieved remarkable results, but no piece was like any other; whereas Europe was already moving toward replication—batch and then mass production. This knowledge of lenses, moreover, was a school for further optical advances, and not only in Italy. Both telescope and microscope were invented in the Low Countries around 1600 and spread quickly from there.

Europe enjoyed a monopoly of corrective lenses for three to four hundred years. In effect they doubled the skilled craft workforce, and more than doubled it if one takes into account the value of experience.⁵

3. *The mechanical clock.* Another banality, so commonplace that we

take it for granted. Yet Lewis Mumford quite correctly called it “the key-machine.”⁶

Before the invention of this machine, people told time by sun (shadow sticks or dials) and water clocks. Sun clocks worked of course only on clear days; water clocks misbehaved when the temperature fell toward freezing, to say nothing of long-run drift as a result of sedimentation and clogging. Both of these devices served reasonably well in sunny climes; but north of the Alps one can go weeks without seeing the sun, while temperatures vary not only seasonally but from day to night.

Medieval Europe gave new importance to reliable time. The Church first, with its seven daily prayer offices, one of which, matins, was in spite of its name a nocturnal rite and required an alarm arrangement to wake clerics before dawn. (Hence our children’s round, *Frère Jacques*: Brother Jacques has overslept and failed to sound the bells for matins.)* And then the new cities and towns had their temporal servitudes. Squeezed by their walls, they had to know and order time in order to organize collective activity and ration space. They set a time to wake, to go to work, to open the market, close the market, leave work, and finally a time to put out fires (*couvre-feu* gives us our word “curfew”) and go to sleep.

All of this was compatible with the older devices so long as there was only one authoritative timekeeper; but with urban growth and the multiplication of time signals, discrepancy brought discord and strife. Society needed a more dependable instrument of time measurement and found it in the mechanical clock.

We do not know who invented this machine or where. It seems to have appeared in Italy and England (perhaps simultaneous invention) in the last quarter of the thirteenth century. Once known, it spread rapidly, driving out the water clocks; but not solar dials, which were needed to check the new machines against the timekeeper of last resort. These early versions were rudimentary, inaccurate, and prone to breakdown—so much so that it paid to buy a clockmaker along with the clock.

Ironically, the new machine tended to undermine ecclesiastical authority. Although Church ritual had sustained an interest in timekeep-

* The English and German versions of the verse (and maybe others) traduce the meaning by saying that “morning bells are ringing.” The point is, they are not ringing.

ing throughout the centuries of urban collapse that followed the fall of Rome, Church time was nature’s time. Day and night were divided into the same number of parts, so that except at the equinoxes, day and night hours were unequal; and then of course the length of these hours varied with the seasons. But the mechanical clock kept equal hours, and this implied a new time reckoning. The Church resisted, not coming over to the new hours for about a century. From the start, however, the towns and cities took equal hours as their standard, and the public clocks installed in the towers and belfries of town halls and market squares became the very symbol of a new, secular municipal authority. Every town wanted one; conquerors seized them as specially precious spoils of war; tourists came to see and hear these machines the way they made pilgrimages to sacred relics. New times, new customs.

The clock was the greatest achievement of medieval mechanical ingenuity. Revolutionary in conception, it was more radically new than its makers knew. This was the first example of a digital as opposed to an analog device: it counted a regular, repeating sequence of discrete actions (the swings of an oscillating controller) rather than tracked continuous, regular motion such as the moving shadow of a sundial or the flow of water. Today we know that such a repeating frequency can be more regular than any continuous phenomenon, and just about all high-precision devices are now based on the digital principle. But no one could have known that in the thirteenth century, which thought that because time was continuous, it ought to be tracked and measured by some other continuity.

The mechanical clock had to meet the unsparing standards of earth and sun; no blinking or hiding its failures. The result was relentless pressure to improve technique and design. At every stage, clockmakers led the way to accuracy and precision: masters of miniaturization, detectors and correctors of error, searchers for new and better. They remain the pioneers of mechanical engineering—examples and teachers to other branches.

Finally, the clock brought order and control, both collective and personal. Its public display and private possession laid the basis for temporal autonomy: people could now coordinate comings and goings without dictation from above. (Contrast the military, where only officers need know the time.) The clock provided the punctuation marks for group activity, while enabling individuals to order their own work (and that of others) so as to enhance productivity. Indeed, the very notion of productivity is a by-product of the clock: once one can relate

performance to uniform time units, work is never the same. One moves from the task-oriented time consciousness of the peasant (one job after another, as time and light permit) and the time-filling busyness of the domestic servant (always something to do) to an effort to maximize product per unit of time (time is money). The invention of the mechanical clock anticipates in its effects the economic analysis of Adam Smith: increase in the wealth of nations derives directly from improvement of the productive powers of labor.

The mechanical clock remained a European (Western) monopoly for some three hundred years; in its higher forms, right into the twentieth century. Other civilizations admired and coveted clocks, or more accurately, their rulers and elites did; but none could make them to European standard.

The Chinese built a few astronomical water clocks in the Tang and Sung eras—complicated and artful pieces that may have kept excellent time in the short run, before they started clogging. (Owing to sediment, water clocks keep a poor rate over time.) These monumental machines were imperial projects, done and reserved for the emperor and his astrologers. The Chinese treated time and knowledge of time as a confidential aspect of sovereignty, not to be shared with the people. This monopoly touched both daily and year-round time. In the cities, drums and other noisemakers signaled the hours (equal to two of our hours), and everywhere the imperial calendar defined the seasons and their activities. Nor was this calendar a uniform, objectively determinable datum. Each emperor in turn had his own calendar, placed his own seal on the passage of time. Private calendrical calculation would have been pointless.

These interval hour signals in large cities were no substitute for continuing knowledge and awareness. In particular, the noises were not numerical signifiers. The hours had names rather than numbers, and that in itself testifies to the absence of a temporal calculus. Without a basis in popular consumption, without a clock trade, Chinese horology regressed and stagnated. It never got beyond water clocks, and by the time China came to know the Western mechanical clock, it was badly placed to understand and copy it. Not for want of interest: the Chinese imperial court and wealthy elites were wild about these machines; but because they were reluctant to acknowledge European technological superiority, they sought to trivialize them as toys. Big mistake.

Islam might also have sought to possess and copy the clock, if only to fix prayers. And as in China, Muslim horologists made water clocks

well in advance of anything known in Europe. Such was the legendary clock that Haroun-al-Raschid sent as a gift to Charlemagne around the year 800: no one at the Frankish court could do much with it, and it disappeared to ignorance and neglect. Like the Chinese, the Muslims were much taken with Western clocks and watches, doing their best to acquire them by purchase or tribute. But they never used them to create a public sense of time other than as a call to prayer. We have the testimony here of Ghiselin de Busbecq, ambassador from the Holy Roman Empire to the Sublime Porte in Constantinople, in a letter of 1560: “. . . if they established public clocks, they think that the authority of their muezzins and their ancient rites would suffer diminution.”⁷ Sacrilege.

4. *Printing.* Printing was invented in China (which also invented paper) in the ninth century and found general use by the tenth. This achievement is the more impressive in that the Chinese language, which is written in ideographs (no alphabet), does not lend itself easily to movable type. That explains why Chinese printing consisted primarily of full-page block impressions; also why so much of the old Chinese texts consists of drawings. If one is going to cut a block, it is easier to draw than to carve a multitude of characters. Also, ideographic writing works against literacy: one may learn the characters as a child, but if one does not keep using them, one forgets how to read. Pictures helped.

Block printing limits the range and diffusion of publication. It is well suited to the spread of classic and sacred texts, Buddhist mantras, and the like, but it increases the cost and risk of publishing newer work and tends to small printings. Some Chinese printers did use movable type, but given the character of the written language and the investment required, the technique never caught on as in the West. Indeed, like other Chinese inventions, it may well have been abandoned for a time, to be reintroduced later.⁸

In general, for all that printing did for the preservation and diffusion of knowledge in China, it never “exploded” as in Europe. Much publication depended on government initiative, and the Confucian mandarin discouraged dissent and new ideas. Even evidence of the falsity of conventional knowledge could be dismissed as appearance.⁹ As a result, intellectual activity segmented along personal and regional lines, and scientific achievement shows surprising discontinuities. “The great mathematician Chu Shih-chieh, trained in the northern school, migrated south to Yang-chou, where his books were printed but he could

find no disciples. In consequence, the more sophisticated of his achievements became incomprehensible to following generations. But the basic scientific texts were common property everywhere."¹⁰ Basic texts, a kind of canonical writ, are not enough; worse, they may even chill thought.

Europe came to printing centuries after China. It should not be thought, however, that printing made the book and invented reading. On the contrary, the interest in the written word grew rapidly in the Middle Ages, especially after bureaucracy and the rise of towns increased demand for records and documents. Government rests on paper. Much of this verbiage, moreover, was written in the vernacular, shattering the hieratic monopoly of a dead but sacred tongue (Latin) and opening the way to wider readership and a literature of dissent.

As a result, scribes could not keep up with demand. All manner of arrangements were conceived to increase reading material. Manuscripts were prepared and bound in separable fascicles; that divided the labor of writing while enabling several people to read the book at the same time. And as in China, block printing came in before movable type, yielding flysheets more than books and once again copiously illustrated. So when Gutenberg published his Bible in 1452–55, the first Western book printed by movable type (and arguably the most beautiful book ever printed), he brought the new technique to a society that had already vastly increased its output of writing and was fairly panting after it. Within the next half century, printing spread from the Rhineland throughout western Europe. The estimated output of incunabula (books published before 1501) came to millions—2 million in Italy alone.

In spite of printing's manifest advantages, it was not accepted everywhere. The Muslim countries long remained opposed, largely on religious grounds: the idea of a printed Koran was unacceptable. Jews and Christians had presses in Istanbul but not Muslims. The same in India: not until the early nineteenth century was the first press installed. In Europe, on the other hand, no one could put a lid on the new technology. Political authority was too fragmented. The Church had tried to curb vernacular translations of sacred writ and to forbid dissemination of both canonical and noncanonical texts. Now it was overwhelmed. The demons of heresy were out long before Luther, and printing made it impossible to get them back in the box.

5. *Gunpowder*. Europeans probably got this from the Chinese in the early fourteenth, possibly the late thirteenth century. The Chinese

knew gunpowder by the eleventh century and used it at first as an incendiary device, both in fireworks and in war, often in the form of tubed flame lances. Its use as a propellant came later, starting with inefficient bombards and arrow launchers and moving on to cannon (late thirteenth century). The efficiency and rationality of some of these devices may be inferred from their names: "the eight-sided magical awe-inspiring wind-and-fire cannon" or the "nine-arrows, heart-penetrating, magically-poisonous fire-thunderer."¹¹ They were apparently valued as much for their noise as for their killing power. The pragmatic mind finds this metaphorical, rhetorical vision of technology disconcerting.

The Chinese continued to rely on incendiaries rather than explosives, perhaps because of their superior numbers, perhaps because fighting against nomadic adversaries did not call for siege warfare.* Military treatises of the sixteenth century describe hundreds of variations: "sky-flying tubes," apparently descended from the fire lances of five hundred years earlier, used to spray gunpowder and flaming bits of paper on the enemy's sails; "gunpowder buckets" and "fire bricks"—grenades of powder and paper soaked in poison; other devices packed with chemicals and human excrement, intended to frighten, blind, and presumably disgust the enemy; finally, more lethal grenades filled with metal pellets and explosives.¹² Some of these were thrown; others shot from bows. One wonders at this delight in variety, as though war were a display of recipes.

The Chinese used gunpowder in powder form, as the name indicates, and got a weak reaction precisely because the fine-grain mass slowed ignition. The Europeans, on the other hand, learned in the sixteenth century to "corn" their powder, making it in the form of small kernels or pebbles. They got more rapid ignition, and by mixing the ingredients more thoroughly, a more complete and powerful explosion. With that, one could concentrate on range and weight of projectile; no messing around with noise and smell and visual effects.

This focus on delivery, when combined with experience in bell founding (bell metal was convertible into gun metal, and the techniques of casting were interchangeable), gave Europe the world's best cannon and military supremacy.¹³

* The Chinese would seem to have been more afraid of rebellion from within than invasion from without. More modern armaments might fall into the wrong hands, and these included those of the generals. Cf. Hall, *Powers and Liberties*, pp. 46–47.

As these cases make clear, other societies were falling behind Europe even before the opening of the world (fifteenth century on) and the great confrontation.* Why this should have been so is an important historical question—one learns as much from failure as from success. One cannot look here at every non-European society or civilization, but two deserve a moment's scrutiny.

The first, Islam, initially absorbed and developed the knowledge and ways of conquered peoples. By our period (roughly 1000 to 1500), Muslim rule went from the western end of the Mediterranean to the Indies. Before this, from about 750 to 1100, Islamic science and technology far surpassed those of Europe, which needed to recover its heritage and did so to some extent through contacts with Muslims in such frontier areas as Spain. Islam was Europe's teacher.

Then something went wrong. Islamic science, denounced as heresy by religious zealots, bent under theological pressures for spiritual conformity. (For thinkers and searchers, this could be a matter of life and death.) For militant Islam, the truth had already been revealed. What led *back* to the truth was useful and permissible; all the rest was error and deceit.¹⁴ The historian Ibn Khaldūn, conservative in religious matters, was nonetheless dismayed by Muslim hostility to learning:

When the Muslims conquered Persia (637–642) and came upon an indescribably large number of books and scientific papers, Sa'd bin Abi Waqqas wrote to Umar bin al-Khattab asking him for permission to take them and distribute them as booty among the Muslims. On that occasion, Umar wrote him: "Throw them in the water. If what they contain is right guidance, God has given us better guidance. If it is error, God has protected us against it."¹⁵

Remember here that Islam does not, as Christianity does, separate the religious from the secular. The two constitute an integrated whole. The ideal state would be a theocracy; and in the absence of such fulfillment, a good ruler leaves matters of the spirit and mind (in the widest sense) to the doctors of the faith. This can be hard on scientists.

As for technology, Islam knew areas of change and advance: one

* For reasons well worth exploring in the context of the history of ideas and the invention of folklore, a number of scholars have recently tried to propagate the notion that European technology did not catch up to that of Asia until the late eighteenth century. The most active source at the moment is the H-World site on the Internet—a magnet for fallacies and fantasies.

thinks of the adoption of paper; or the introduction and diffusion of new crops such as coffee and sugar; or the Ottoman Turkish readiness to learn the use (but not the making) of cannon and clocks. But most of this came from outside and continued to depend on outside support. Native springs of invention seem to have dried up. Even in the golden age (750–1100), speculation disconnected from practice: "For nearly five hundred years the world's greatest scientists wrote in Arabic, yet a flourishing science contributed nothing to the slow advance of technology in Islam."¹⁶

The one civilization that might have surpassed the European achievement was China. At least that is what the record seems to show. Witness the long list of Chinese inventions: the wheelbarrow, the stirrup, the rigid horse collar (to prevent choking), the compass, paper, printing, gunpowder, porcelain. And yet in matters of science and technology, China remains a mystery—and this in spite of a monumental effort by the late Joseph Needham and others to collect the facts and clarify the issues. The specialists tell us, for example, that Chinese industry long anticipated European: in textiles, where the Chinese had a water-driven machine for spinning hemp in the twelfth century, some five hundred years before the England of the Industrial Revolution knew water frames and mules;¹⁷ or in iron manufacture, where the Chinese early learned to use coal and coke in blast furnaces for smelting iron (or so we are told) and were turning out as many as 125,000 tons of pig iron by the later eleventh century—a figure reached by Britain seven hundred years later.¹⁸

The mystery lies in China's failure to realize its potential. One generally assumes that knowledge and know-how are cumulative; surely a superior technique, once known, will replace older methods. But Chinese industrial history offers examples of technological oblivion and regression. We saw that horology went backward. Similarly, the machine to spin hemp was never adapted to the manufacture of cotton, and cotton spinning was never mechanized. And coal/coke smelting was allowed to fall into disuse, along with the iron industry as a whole. Why?

It would seem that none of the conventional explanations tells us in convincing fashion why technical progress was absent in the Chinese economy during a period that was, on the whole, one of prosperity and expansion. Almost every element usually regarded by historians as a major contributory cause to the industrial revolution in north-western Europe was also present in China. There had even been a revolution in the relations between social classes, at least in the countryside; but this had had no important ef-

fect on the techniques of production. Only Galilean-Newtonian science was missing; but in the short run this was not important. Had the Chinese possessed, or developed, the seventeenth-century European mania for tinkering and improving, they could easily have made an efficient spinning machine out of the primitive model described by Wang Chen. . . . A steam engine would have been more difficult; but it should not have posed insuperable difficulties to a people who had been building double-acting piston flame-throwers in the Sung dynasty. The crucial point is that nobody tried. In most fields, agriculture being the chief exception, Chinese technology stopped progressing well before the point at which a lack of scientific knowledge had become a serious obstacle.¹⁹

Why indeed? Sinologists have put forward several partial explanations. The most persuasive are of a piece:

- The absence of a free market and institutionalized property rights. The Chinese state was always interfering with private enterprise—taking over lucrative activities, prohibiting others, manipulating prices, exacting bribes, curtailing private enrichment. A favorite target was maritime trade, which the Heavenly Kingdom saw as a diversion from imperial concerns, as a divisive force and source of income inequality, worse yet, as an invitation to exit. Matters reached a climax under the Ming dynasty (1368–1644), when the state attempted to prohibit all trade overseas. Such interdictions led to evasion and smuggling, and smuggling brought corruption (protection money), confiscations, violence, and punishment. Bad government strangled initiative, increased the cost of transactions, diverted talent from commerce and industry.

- The larger values of the society. A leading sociological historian (historical sociologist) sees gender relations as a major obstacle: the quasi-confinement of women to the home made it impossible, for example, to exploit textile machinery profitably in a factory setting. Here China differed sharply from Europe or Japan, where women had free access to public space and were often expected to work outside the home to accumulate a dowry or contribute resources to the family.²⁰

- The great Hungarian-German-French sinologist, Etienne Balazs, would stress the larger context. He sees China's abortive technology as part of a larger pattern of totalitarian control. He does not explain this by hydraulic centralism, but he does recognize the absence of freedom, the weight of custom, consensus, what passed for higher wisdom. His analysis is worth repeating:

. . . if one understands by totalitarianism the complete hold of the State and its executive organs and functionaries over all the activities of social life, without exception, Chinese society was highly totalitarian. . . . No private initiative, no expression of public life that can escape official control. There is to begin with a whole array of state monopolies, which comprise the great consumption staples: salt, iron, tea, alcohol, foreign trade. There is a monopoly of education, jealously guarded. There is practically a monopoly of letters (I was about to say, of the press): anything written unofficially, that escapes the censorship, has little hope of reaching the public. But the reach of the Moloch-State, the omnipotence of the bureaucracy, goes much farther. There are clothing regulations, a regulation of public and private construction (dimensions of houses); the colors one wears, the music one hears, the festivals—all are regulated. There are rules for birth and rules for death; the providential State watches minutely over every step of its subjects, from cradle to grave. It is a regime of paper work and harassment [*paperasseries et tracasseries*], endless paper work and endless harassment.

The ingenuity and inventiveness of the Chinese, which have given so much to mankind—silk, tea, porcelain, paper, printing, and more—would no doubt have enriched China further and probably brought it to the threshold of modern industry, had it not been for this stifling state control. It is the State that kills technological progress in China. Not only in the sense that it nips in the bud anything that goes against or seems to go against its interests, but also by the customs implanted inexorably by the *raison d'Etat*. The atmosphere of routine, of traditionalism, and of immobility, which makes any innovation suspect, any initiative that is not commanded and sanctioned in advance, is unfavorable to the spirit of free inquiry.²¹

In short, no one was trying. Why try?

Whatever the mix of factors, the result was a weird pattern of isolated initiatives and sisyphian discontinuities—up, up, up, and then down again—almost as though the society were held down by a silk ceiling. The result, if not the aim, was change-in-immobility; or maybe immobility-in-change. Innovation was allowed to go (was able to go) so far and no farther.

The Europeans knew much less of these interferences. Instead, they entered during these centuries into an exciting world of innovation and emulation that challenged vested interests and rattled the forces of conservatism. Changes were cumulative; novelty spread fast. A new sense of progress replaced an older, effete reverence for authority. This intoxicating sense of freedom touched (infected) all domains. These

were years of heresies in the Church, of popular initiatives that, we can see now, anticipated the rupture of the Reformation; of new forms of expression and collective action that challenged the older art forms, questioned social structures, and posed a threat to other polities; of new ways of doing and making things that made newness a virtue and a source of delight; of utopias that fantasized better futures rather than recalled paradises lost.

Important in all this was the Church as custodian of knowledge and school for technicians. One might have expected otherwise: that organized spirituality, with its emphasis on prayer and contemplation, would have had little interest in technology. Surely the Church, with its view of labor as penalty for original sin, would not seek to ease the judgment. And yet everything worked in the opposite direction: the desire to free clerics from time-consuming earthly tasks led to the introduction and diffusion of power machinery and, beginning with the Cistercians, to the hiring of lay brothers (*conversi*) to do the dirty work. Employment fostered in turn attention to time and productivity. All of this gave rise on monastic estates to remarkable assemblages of powered machinery—complex sequences designed to make the most of the waterpower available and distribute it through a series of industrial operations. A description of work in the abbey of Clairvaux in the mid-twelfth century exults in this versatility: “cooking, straining, mixing, rubbing [polishing], transmitting [the energy], washing, milling, bending.” The author, clearly proud of these achievements, further tells his readers that he will take the liberty of joking: the fulling hammers, he says, seem to have dispensed the fullers of the penalty for their sins; and he thanks God that such devices can mitigate the oppressive labor of men and spare the backs of their horses.²²

Why this peculiarly European *joie de trouver*? This pleasure in new and better? This cultivation of invention—or what some have called “the invention of invention”? Different scholars have suggested a variety of reasons, typically related to religious values:

1. The Judeo-Christian respect for manual labor, summed up in a number of biblical injunctions. One example: When God warns Noah of the coming flood and tells him he will be saved, it is not God who saves him. “Build thee an ark of gopher wood,” he says, and Noah builds an ark to divine specifications.

2. The Judeo-Christian subordination of nature to man. This is a sharp departure from widespread animistic beliefs and practices that saw something of the divine in every tree and stream (hence naiads and dryads). Ecologists today might think these animistic beliefs preferable

to what replaced them, but no one was listening to pagan nature worshippers in Christian Europe.

3. The Judeo-Christian sense of linear time. Other societies thought of time as cyclical, returning to earlier stages and starting over again. Linear time is progressive or regressive, moving on to better things or declining from some earlier, happier state. For Europeans in our period, the progressive view prevailed.

4. In the last analysis, however, I would stress the market. Enterprise was free in Europe. Innovation worked and paid, and rulers and vested interests were limited in their ability to prevent or discourage innovation. Success bred imitation and emulation; also a sense of power that would in the long run raise men almost to the level of gods. The old legends remained—the expulsion from the Garden, Icarus who flew too high, Prometheus in chains—to warn against hubris. (The very notion of *hubris*—cosmic insolence—is testimony to some men’s pretensions and the efforts of others to curb them.)

But the doers were not paying attention.

5

The Great Opening

The greatest thing since the creation of the world, except for the incarnation and death of Him who created it, is the discovery of the Indies.

—FRANCISCO LOPEZ DE GOMARA, *History of the Indies*

There is one historical event which everybody knows. Even those whose predilections do not turn toward history know that Christopher Columbus discovered America. This general knowledge of one fact indicates how that singular achievement, the discovery of a New World, has captivated the sentiment of all Europe and all America as the most notable event in secular history.

—F. A. KIRKPATRICK, *The Spanish Conquistadores*

“You’re a lost civilization!” crowed the anthropologist to the Indian chief. “We don’t mind being lost,” answered the chief. “It’s being found that scares us.”

Not long ago the world was getting ready to celebrate the five hundredth anniversary of Columbus’s discovery of America. One group after another competed to honor the man and the achievement. In the United States, which some would have named Columbia, where some seventy cities and towns and a large number of fair and fraternal institutions bear the discoverer’s name, where people of Italian descent have vied with Hispanics to draw merit and honor from their countryman (whether by descent or adoption), one could reasonably expect a repetition *en grand* of the quadricentennial of 1892: a world’s fair (the Columbian Exposition); mementos galore; and the following year, richly colored issues of commemorative stamps.

People felt good about Columbus in those days, and the expectation was that 1992 would be bigger and better (500 beats 400); but then something, everything, went wrong. Columbus, symbol of historical achievement, midwife of a new world, turned out to be a political embarrassment. It emerged—but there had been rumblings of dissent for years—that many people did not see the Admiral of the Ocean Sea as a hero, the European arrival in the New World as a discovery, the anniversary of this event as occasion for celebration.¹

On the contrary. Columbus was now portrayed as a villain; the Europeans as invaders; the native inhabitants as innocent, happy people reduced to bondage and eventually wiped out by the rapacious, disease-carrying white man.² In Berkeley, California, long a secessionist, irreverent (or rather, differently reverent) municipal enclave with its own foreign policy, the City Council renamed Columbus Day Indigenous Peoples’ Day and offered two performances of an opera entitled *Get Lost (Again)*, *Columbus*, the work of a Native American composer named White Cloud Wolfhawk.³ Two years later, by way of affirming a choice, Mexico decided to issue commemorative coins in honor of the Aztecs and “a civilization of incredible sophistication in the arts, science and culture.”⁴ No praise for conquistadors.

Now, it was obviously not possible to erase or reverse history. No one was planning to evacuate and return to Europe; it was too late for Columbus to find his way. But there was enough anti-Columbus sentiment, especially in politically correct circles, to make rejoicing as out of place as a jig at a wake. So, no pageants; no souvenirs; no T-shirts and logos; no product endorsements; no reenactments (who could agree on the terms?); no oratory; no stamps; no coins; no prizes. And when the National Gallery of Art in Washington, D.C., decided to do a quincentenary exhibit with thick glossy-paper catalogue, it did an ABC—Anything But Columbus.⁵ The exhibit covered the rest of the world, the other events of 1492 and years around. The most important event of all was deliberately omitted. History eviscerated.

As in most iconoclastic subversions of tradition, the attack on Columbus—or more accurately, on what followed his arrival—contains much truth, much nonsense, and some irrelevancy.

The *truth* lies in the unhappy fate of the indigenous peoples the Europeans found in the New World. With rare, trivial, and ineffectual exceptions, they were treated with contempt, violence, and sadistic brutality. They were almost wiped out by the microbes and viruses the Europeans unknowingly brought with them. Their land and culture and dignity were taken from them. They have nothing to celebrate.

The *nonsense* lies in quibbles about discovery: How could Columbus have discovered the New World? It was always there. The natives knew their land. It was they who had discovered it long before.* (We may

* Jean Ziegler, *La victoire des vaincus*, p. 101, cites a Russian novel of the 1960s, *Aj-vanhu*, by Juryi Rychten (the Polish translation is dated 1966) that has its Siberian hero complain: “I have never been able to understand how anyone can discover land that